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Metro Denver Sludge Management Plan

Engineering-Science, Inc, Berkeley, Calif

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This volume summarizes the information contained in the two volumes dealing with the Metro Denver Sludge Management Plan. The summary describes the problems with current Metro Denver sludge handling that led up to the current plan. A brief description of the proposed sludge recycling project is presented. The summary then highlights the primary impacts of the project.

A final section contains a definition of the thirty-one issues considered to be the most significant about this project. These issues are discussed and resolved in Volume II of this EIS. The summary presents the main conclusions regarding these issues.

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SUMMARY

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E.I.S.

METRO DENVER SLUDGE MANAGEMENT PLAN

by

U.S. ENVIRONMENTAL PROTECTION AGENCY

and

ENGINEERING-SCIENCE

February 1978

Approved by: Alan Merson
Regional Administrator

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SUMMARY

WHERE WE STAND

In May 1976, Region VIII EPA released a draft environmental impact statement (referred to as an EIS) about the Denver Metro Sludge Management Facilities Plan. This document explained the project, its impacts and the main alternatives as EPA saw it. This EIS was written in accordance with the National Environmental Policy Act as will be explained below. A summary document was included with this EIS; it discussed what EPA felt to be the most important issues on this project.

The different volumes in this package are the final EIS on this project. Volume I is an updated version of the draft EIS. It details the project's impacts, both short- and long-term, direct and indirect, possible mitigating measures and alternatives in the manner required under NEPA. Volume II contains the written responses and comments on the draft EIS by State, Federal and local agencies and concerned citizens. The EPA reply to each comment is provided side-by-side for easy reading. This volume also identifies the issues we now believe most important on this project. We have also provided a detailed discussion of these issues and how we think they can or should be resolved. In this Summary, these issues are listed and the proposed method of resolving them is presented.

EPA held public hearings in Denver and at the Adams County Fairgrounds on September 8th and 9th, 1976. Both oral and written testimony taken from these hearings as well as written comments were used to develop the issues discussions.

It has been a difficult and time-consuming task to prepare the final EIS. EPA staff personnel have negotiated with a number of different parties involved in the project to come up with resolutions of issues. We have attempted to incorporate the latest information available on controversial issues in particular.

The final EIS will be distributed to persons and agencies who have indicated an interest in the project (by letter or at the hearings). This Summary will attempt to explain where the final EIS effort was directed. We presume that you have already read the draft EIS.

By releasing this final EIS, EPA intends to approve the Metro Denver Sludge Management Plan with certain conditions. These conditions are spelled out briefly in the Summary issues discussion and in Appendix A of Volume II in more detail. This approval means that Metro Denver will be eligible to receive Step II design funds and eventually Step III construction funds for this project.

EPA will not approve the plan until 30 days after release of the final EIS. We will be willing to give some additional time for review and discussion if anyone so requests by phone or by letter before the end of the 30-day period.

WHY THIS E.I.S.?

In 1969 a law of far-reaching significance for Federal agencies was passed by Congress. This law, called the National Environmental Policy Act (and referred to as NEPA), requires a Federal agency to take account of and make known the environmental impacts of any major action it is about to undertake. The agency must decide whether a given action is a major one that will have a significant effect on the environment. The document that a Federal agency must prepare on such a major action is called an environmental impact statement (the EIS).

EPA and NEPA--the difference

The Environmental Protection Agency (EPA) is responsible for seeing to it that many of the environmental laws passed by Congress are put into effect; however, it is also one among many Federal agencies which must also comply with NEPA in its own actions. The action EPA could take in this case is the approval of a plan by the Metropolitan Denver Sewage Disposal District No. 1 or 'Metro' to design and construct a sludge processing and disposal system in Adams County.

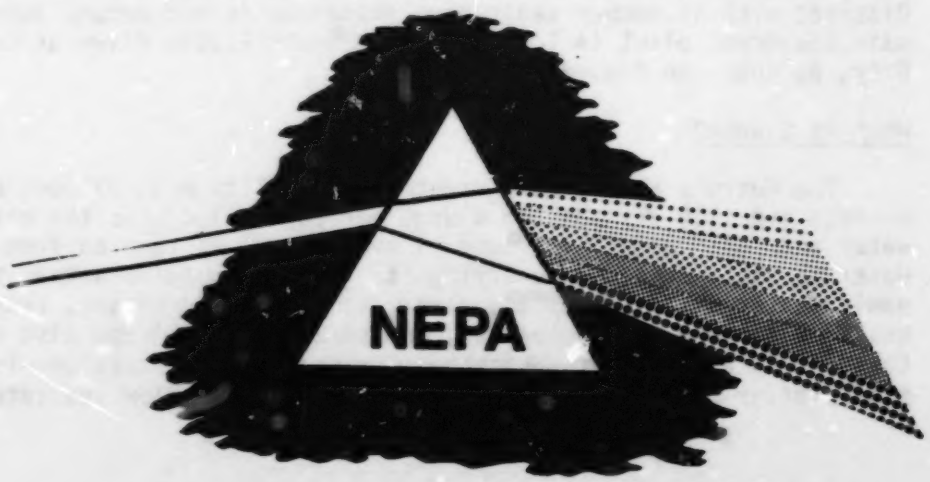
Under the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), EPA is responsible for approving such plans for water pollution control improvements of municipal sewage treatment systems. As part of this law, Congress set aside $18 billion for design and construction of facilities, which EPA has the responsibility for distributing. Should this plan be approved for funding, 75 percent of the eligible portion of the project could be paid for with a Federal grant. The recently passed Amendments of 1977 to the Clean

Water Act provide another $25 billion dollars for wastewater treatment funding.

EPA decided that the proposed Metro project involved significant environmental impacts, and therefore has written this environmental impact statement. The National Environmental Policy Act requires a thorough review of the EIS by other Federal agencies, State agencies, local governments and interested citizens. The idea is to get the benefit of expertise both of other agencies and of citizens, as well as to inform the public of what is about to take place. The EPA must carefully weigh the comments it receives before any final action can be taken.

The legal obligation under the National Environmental Policy Act is to circulate the draft EIS to agencies and persons having expertise on the subject or an interest in its outcome. The comments then received as written replies or through the public hearing process must then be reflected in the development of the final EIS. The final EIS must similarly be circulated to expert agencies and the public for a minimum 30-day period. Although NEPA EIS's have not always been viewed as decision documents, EPA takes the position that its final EIS is a decision-making point. Therefore, according to our own regulations on NEPA, we have tried to sort through the project's various benefits and impacts and corrective measures to arrive at a point where we feel comfortable with proceeding with this project.

At a minimum, the EIS is a public disclosure document. The discussion of environmental impacts includes both direct and indirect impacts to the extent that they can be predicted. NEPA requires disclosure of impacts of an irreversible or long-lasting nature. A very important feature of the impact statement is its attempt to propose ways to lessen the negative impacts identified. These methods are known as "Mitigative Measures".



It should be made clear that the term "environment," as used in the National Environmental Policy Act, is very broad; it applies to people and social institutions as well as the biological and physical world.

The Facilities Plan

Because of problems with its present sludge disposal system, the Metro District has developed a plan to dispose of its sludge by recycling it to the land. Formally, the plan is called a facilities plan under Public Law 92-500. A mechanism for parcelling grant monies was developed whereby an applicant such as Metro, after having been given priority standing by the State, would develop and submit a facilities plan. This is known as STEP I. This plan must meet State water quality goals as well as the Congressionally ordered goals (viz., wherever possible, the nation's streams would become fishable and swimmable, maximum recycling of resources, etc.). EPA has also developed, in its construction grant regulations, a fairly lengthy list of what other information must be presented in a facilities plan. Among these requirements is an environmental assessment that helps EPA to decide upon the environmental importance of the project. It is only after EPA has fulfilled its obligation under the National Environmental Policy Act that STEP II funds can be awarded for design. After the State has approved these design plans, a STEP III construction grant can be made. Further on in this summary, we briefly explain how Metro's plan has been changed in this EIS process.

THE PROBLEM AND THE PLAN

Metropolitan Denver Sewage Disposal District No. 1 (Metro) provides sewage treatment for most of the Denver metropolitan area. It is a District with 52 member sanitation districts in and around Denver. The main treatment plant is located on the South Platte River at Commerce City, as shown on Figure A.

What is Sludge?

The Metro's (wastewater treatment) facility must dispose of on the average over 100 dry tons of sludge per day. Sludge is the mixture of water and solid materials found in sewage that is removed from wastewater in the process of purifying it. Sludge contains water, the organic matter of human wastes, paper, some oils and grease, traces of heavy metals and other elements, and some salts. Sludge also contains those critical nutrients--nitrogen, phosphate and potassium--in quantities similar to commercial fertilizers. Table A below indicates the

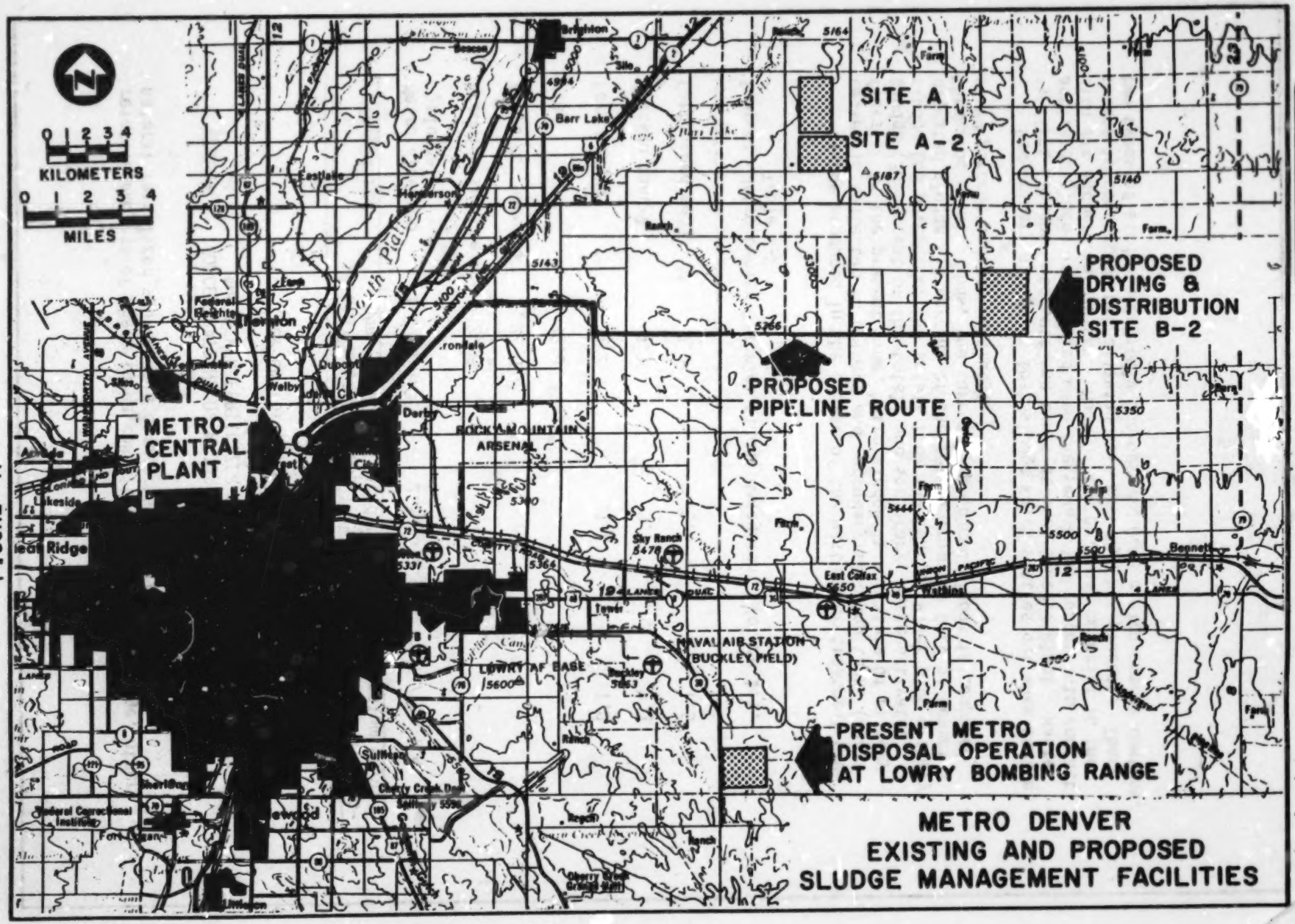


FIGURE A

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relative amounts of these three constituents in Metro sludge, other natural fertilizer sources and commercial fertilizer.

Table A. CONCENTRATIONS OF MAJOR PLANT NUTRIENTS IN SLUDGE AND OTHER FERTILIZER SOURCES

(percent of dry weight)

Fertilizer	Total nitrogen (N)	Total phosphoric acid (P_2O_5)	Acid-soluble potassium (K_2O)
Metro digested sludge	3.0 to 4.0	2.3 to 3.4	0.7 to 1.4
Ammonium sulfate	20.5	-	-
Anhydrous ammonia	82.0		
Urea	38.0		
Farm manure	1.2	1.2	1.2
Chicken manure	4.1	3.7	2.3
Cottonseed meal	7.0	2.5	1.5

Source: Metro Denver District Sludge Management, Volume III, Table 7-2.

Sludge produced in the course of the wastewater treatment processes is collected in primary and secondary settling tanks (clarifiers). At the present time, Metro sludge is a mixture of primary sludge (30 percent of the total) and secondary, waste-activated, sludge (58 percent of the total) from the Central Plant plus primary digested sludge (12 percent of the total) from the City of Denver's Northside plant. Thus, the currently produced sludge is composed of 88 percent undigested sludge.

Raw primary sludge is that sludge which settles out when sewage is first brought into settling tanks at the Central Plant. Waste-activated sludge is produced when the sewage is brought into contact with air and microorganisms. Much of the original material in the sewage is converted into a living cell mass by this process. These two types of sludge are highly odorous and have a high energy content.

In both types of sludge it is extremely difficult to separate the solid matter from the water in the sludge.

Anaerobically digested sludge is produced in large, covered tanks using a self-sustaining, slow microbial combustion process that reduces the energy content of primary and secondary waste-activated sludge, as well as to break down the more complex, odorous compounds in the sludge. What is left is a relatively inert, dark material, rich in nitrogen, phosphate, and trace elements. Anaerobic digestion generally performs in short time the natural breakdown of complicated organic material that is continually occurring in nature.

Metro's Current Sludge Operation

The District now handles the sludge produced at the two plants by first chemically treating it to reduce possible harmful bacteria and other organisms and to make it possible to remove greater amounts of water from the sludge. The sludge is "de-watered" and then hauled by truck to a part of the Lowry Bombing Range area that is leased by the City and County of Denver for solid waste disposal, shown on Figure A. There, it is spread over the surface of the land and disc-plowed into the topsoil after some air drying has taken place.

Although this method of disposal has shown some positive benefits (such as improved forage for cattle), there are a number of outstanding problems with the present system:

First, the present sludge mixture is not of the proper type for land recycling. Metro must use large doses of lime and ferric chloride to disinfect the raw and primary sludge, to control odors, and to dewater the sludge. This is expensive and adds large amounts of chemicals (up to 30 percent of the dry weight of the sludge) to the soil, with no benefit. Furthermore, odors from these sludges are difficult to control.

Second, the amounts of sludge now spread on the Lowry Bombing Range are great enough to cause concern about eventual effects on the groundwater. The loading rates are excessive for the purpose of using the sludge's nutrients on this kind of land in Denver's semi-arid climate, given the limited area where sludge can now be spread.

Third, Metro's existing sludge treatment and disposal system is nearing its capacity in some units. Funds will have to be granted either to expand the present system or to find another alternative.

Finally, the system is expensive and highly energy-consuming. Metro would like to cut operating costs while at the same time trying to find a way to use the nutrients and soil-building potential of the sludge.

Metro's Sludge Recycling Plans

With the above problems in mind, Metro began searching for a method of disposing of its sludge in a way that it could be of use on agricultural lands. Metro originally proposed a system of spraying sludge on dryland farming areas to the northeast of Denver in Adams County. The lands would have either been owned outright and farmed by Metro or leased back to local farmers. This system, however, was highly criticized by the local farming community because of the high loading rates suggested for dryland farming. Farmers were also not happy with the prospect of having Metro as a governmental competitor in the farming business. Fears were also expressed about odors and the loss of land values around the site.

The Metro District then reviewed its original plans with its engineering consultant, Cornell, Howland, Hayes, Merryfield and Hill (CH2M-Hill for short), and came up with a more flexible plan for recycling sludge to the land. Instead of getting into the farming business itself, Metro now proposes in their facilities plan to build a drying, storage and distributing center on the same general area it had proposed for the spraying/farming operation. After the sludge has been pumped and dried at the site, the sludge could then be sold at some reasonable charge to metropolitan area users. The system would take advantage of plentiful solar heat to dry the sludge.

Features of the Metro Proposal--

Anaerobic Digesters--At the Metro Central Plant, the system would make use of new anaerobic digesters. These digesters are an essential part of any land application plan for sludge. They allow sewage solid material to be fermented in an air-free environment for a period of 22 days on the average, resulting in a stabilized and relatively odor-free sludge.

This product, then, is the material that would be pumped some 22 miles by pipeline to the drying-storage site. At this time, the only fully operational digesters in the Metro system are at the Denver Northside (DNS) Plant about a mile upstream of the Central Plant. Its sludge accounts for only a small percentage of Metro's total sludge to be disposed of. Metro is responsible for further processing and disposal of the DNS sludge. It may be of interest to note that at present, Metro is dewatering the DNS sludge separately from the rest of Metro's sludge. The Denver Parks Department has been using the DNS sludge on parklands, and Metro is storing and drying the DNS sludge in a small area of the Lowry Bombing Range for use by the Parks Department.

Recently, EPA gave the Metro District a construction grant to

build enough anaerobic digesters to handle all of Metro's present and projected sludge loads to 1985. The grant was given with the understanding that EPA would not be committed to approval of any final method of disposal of the sludge. It was expected that the anaerobic digesters would be beneficial to the Metro system no matter what type of final disposal was selected. Some disposal alternatives (such as incineration) might operate better without digestion, but enough options would still remain available for disposal to permit such a grant. Thus, for all practical purposes, anaerobic digestion of sludge must be considered a part of any future sludge handling plans. Metro District has now begun using these digesters to process its own raw primary sludge.

Sludge Transport--The liquid digested sludge would be pumped from the Central Plant through two pipelines, using two pumping stations (at the Plant and midway), to the sludge drying, storage and distribution center 22 miles east of the Central Plant in Adams County.

Sludge Drying, Storage and Distribution--Metro's proposed system calls for a site in western Adams County in Range 64 West, Township 2 South, comprising Sections 16 and 21 and the western halves of Sections 15 and 22. This site is known as B-2, as shown on Figure A. Sludge would be air dried in lined earthen basins for about six months. Then it would be scraped and stockpiled for another six months prior to shipment for reuse.

The site would include 600 acres of drying basins within its total 2,000-acre area. Two impoundments are planned for capturing all surface runoff from the site. A smaller area would be used to stockpile the dried sludge on the land surface. A variety of research and demonstration plots would surround the drying area, as shown on Figure 3 in Volume I of the EIS. Metro plans to use the site for emergency disposal by underground injection of soured digester sludge only.

Land Application of Sludge--The heart of the proposal is to provide Metro dried sludge to willing users in the entire metropolitan area. Metro has indicated that potential areas of use include irrigated farms, dryland farms, sod farms, Denver parks and other metropolitan parks, and mine spoil areas. Metro has also received a considerable number of letters from individual home owners who would like to use the sludge on home gardens and lawns. Other possible candidates include a company interested in bagging and marketing dried sludge fortified with additional fertilizer nutrients. Another company proposes to utilize sludge and garbage as a fuel source for a coal gasification plant. To a great extent, the success of Metro's proposal will depend on the ability to develop a market for the sludge.

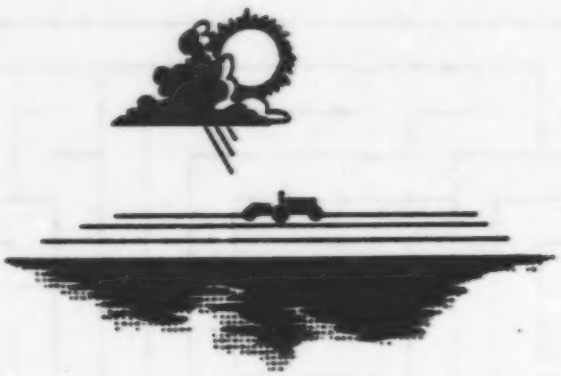
THE ANALYSIS IN THIS E.I.S.

The National Environmental Policy Act requires that an EIS evaluate the following five items: (1) the environmental impact of the action, (2) alternatives, (3) adverse impacts that cannot be mitigated, (4) irreversible and irretrievable commitments and (5) short-range versus long-term resource tradeoffs. Because EPA has been given the responsibility by Congress to develop overall pollution control approaches to wastewater treatment (including sludge treatment and disposal), EPA is also very much interested in seeing that the best possible methods are incorporated into sludge processing and disposal projects. EPA has generally endorsed the idea of recycling waste materials wherever it is cost-effective and environmentally suitable. This includes making use of the nutrient and soil-building benefits in municipal sludge.

EPA is also aware of the myriad problem areas in applying this general concept to a particular situation. Denver's case, for example, requires a close look at the peculiarities of climate, soils, water availability, the groundwater situation, health effects, system design and a host of other factors. All environmental areas--biological, cultural and physical--must be considered and protected in evaluating such a proposed system. EPA considers impacts occurring

"offsite", that is, where the sludge will ultimately be applied, to be of critical importance. Factors such as loading rates, the condition of the sludge, what the uses of the land are and how well control will be exercised over areas receiving the sludge are important in deciding the overall merits of the proposal. The EIS is EPA's tool for evaluating these areas of concern on a site-specific level. Because of the obvious concerns about the impacts of the site B-2 drying/storage operation, the final EIS has concentrated more on these site issues.

In preparing this environmental impact statement, EPA hired an environmental consultant to help evaluate the project.

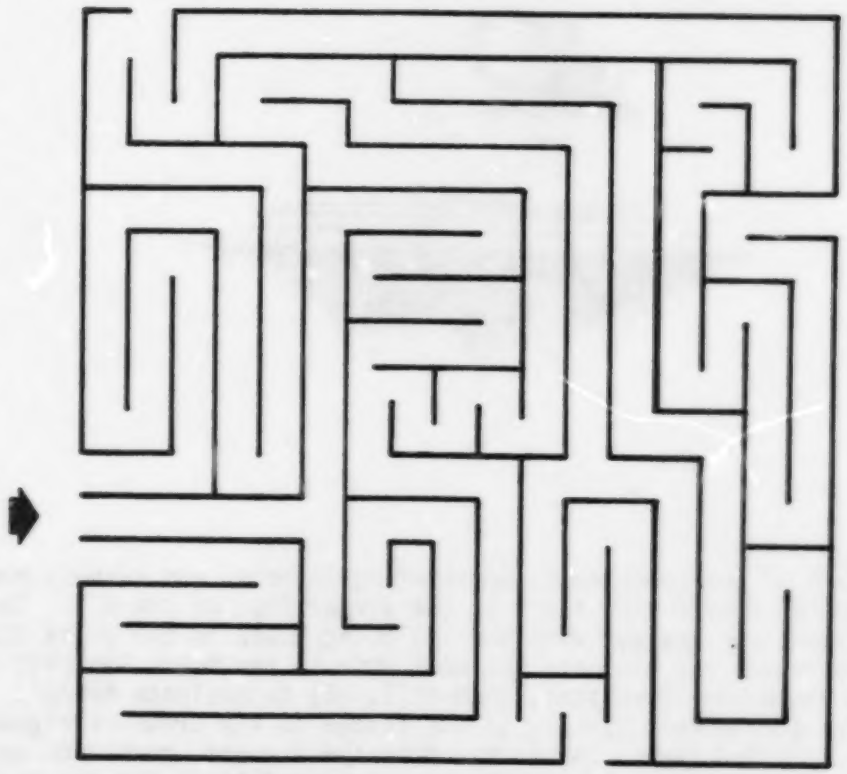


The work of the consultant, Engineering-Science, was closely managed by the EPA Region VIII staff in the preparation of the EIS. The consultant was charged with the following tasks in the draft EIS: (1) to review and evaluate the work done by the Metro District and its engineering consultant, CH2M-Hill, (2) to evaluate Metro's tentative proposals for use of the sludge in six areas--irrigated farms, dryland farms, sod farms, mine-spoil areas, parklands and home gardens and (3) to develop its recommendations for any measures it felt were needed to protect any and all environmental areas. The environmental consultant evaluated the costs of 17 different sludge treatment and disposal systems and compared them for environmental and engineering tradeoffs.

EPA specifically asked the consultant to evaluate the two most likely alternatives to Metro's proposal: continuation of the existing system at Lowry and the combination of Metro's sludge with a Denver solid waste recycling system under study by the Denver Regional Council of Governments (DRCOG). The latter involved possible use of sludge with solid waste in the Denver area for supplementary fuel or for production of synthetic gas.

In the final EIS, the consultant analysed many of the issues concerning site B-2. Some of the recommendations for changes for the project were developed by the consultant.

THE ALTERNATIVES



The draft EIS considered both entirely new sludge treatment and disposal systems as well as options within the basic Metro plan, as alternatives. These subsystem options included changes in site

location, sizing, and drying-basin design. The final EIS goes into more detail on site location alternatives, drying basin design (to protect water quality), and a new issue of separate versus combined treatment for the Denver Northside Plant. Additional treatment alternatives such as pyrolysis were briefly evaluated.

Alternatives to the Overall Metro Plan

EPA first reviewed the work that had been done by others in developing overall system alternatives. Metro had considered three basic options in its 1972 Predesign Study: the present disposal system at Lowry, incineration, and a form of land recycling using sludge spraying equipment. CH2M-Hill performed a more detailed evaluation of sludge processing and disposal alternatives in Volume II of the facilities plan. Eight systems were selected for detailed comparison, including the present system, the proposed drying/distribution method, composting, the use of heat treatment technology and incineration. Engineering-Science was asked to evaluate combined solid waste-sludge systems, the eight facilities plan alternatives and additional feasible systems.

The solid waste-sludge combination seemed promising at first, but the defeat in the State legislature of a bill to provide funding for such a system has made this option much less realistic. To a great extent, the compatability of the two wastes would depend on the system eventually selected by DRCOG. For example, sludge would not fit well with the use of solid wastes for supplemental fuel; however, a combination composting system could use sludge fairly well.

CH2M-Hill and Engineering-Science both concluded that the Metro overall proposal was probably the most economical for Metro and likely the best overall system. Engineering-Science's cost evaluation is found in Appendix A of Volume I of the EIS.

EPA prepared its own general comparative evaluation, using environmental, engineering and economic criteria, for this EIS. This evaluation, presented in Section II and summarized in Table 2 of Volume I, includes general sludge disposal options; EPA feels that the ultimate disposal choice in the overall sludge processing system has the most important environmental implications. EPA likewise concludes from an overall standpoint that the land recycling approach is generally preferable to other alternatives, for the Metro situation.

In the draft EIS, EPA decided that two basic alternatives should be considered further and evaluated in detail: Metro's proposed

system and the existing Lowry system. The latter must be considered further because it is an ongoing system, and future changes to the system might make it more economical and environmentally less damaging. At present, there are no Federal funds available for construction of the proposed Metro system. Therefore, Metro might have to continue to use the Lowry area for a number of years.

For a number of reasons, the alternative systems at Lowry have not proved favorable. The final EIS concentrates its discussion of Lowry options to the use of the Lowry Bombing Range as a site for the solids recycling/drying project proposed for site B-2.

Alternatives to Portions of the Metro Plan

The EIS evaluates possible alternatives within these two systems. In the Metro proposal, alternative sites for the sludge drying and distribution center were evaluated. EPA reviewed the comparisons of 11 sites in a 1973 study developing the agricultural reuse program. EPA also reviewed the evaluation of three sites selected by Metro for more intensive consideration in the facilities plan. In Volume II, a discussion of other suggested sites is presented, specifically the areas at the Lowry Bombing Range and the Rocky Mountain Arsenal. Part of the assignment of Engineering-Science was to evaluate the site location from the standpoint of costs and energy requirements for hauling sludge by truck to possible sludge reuse areas.

It appears that the proposed site B-2 shown in Figure A is a reasonable choice for a sludge drying and distribution center. No one site appears to be completely favorable when all factors (such as nearness to markets, elevation, soils, nearness of human habitation, land values, etc.) are considered. It is perhaps more important, from an environmental viewpoint, to design correctly for the site-specific conditions, whatever the site chosen. More information on soils and groundwater is now available for proper evaluation of site differences and impacts and to suggest proper controls to protect the surrounding environment.

Other subsystem alternatives considered for the Metro system were: digestion, conditioning, transportation of the sludge, drying basin design, controls at land application sites and the sizing of the system. Anaerobic, mesophilic digestion appears to be the only realistic conditioning alternative at this point. Furthermore, there appears to be little problem with the choice of pipeline route or pipeline design selected.

Design of the drying basins will be changed to protect groundwater quality. Metro will have to demonstrate that there will be no groundwater problem with its proposal during operation or will face further controls.

In order to reduce the amounts of some heavy metals in the sludge, Metro will eventually be required to institute some control over industrial discharges into the sewer system. The most critical need for control would likely involve discharges of cadmium and nickel into the system.

The question of who should be allowed to use the sludge will be debated from a public health standpoint. Either restrictions could be placed on the types of users, or the system design could be changed to produce a sludge so benign as to allow for the whole range of possible users, without any potential health hazard. This will be decided on a state-wide basis through agricultural use regulations.

System Capacity--

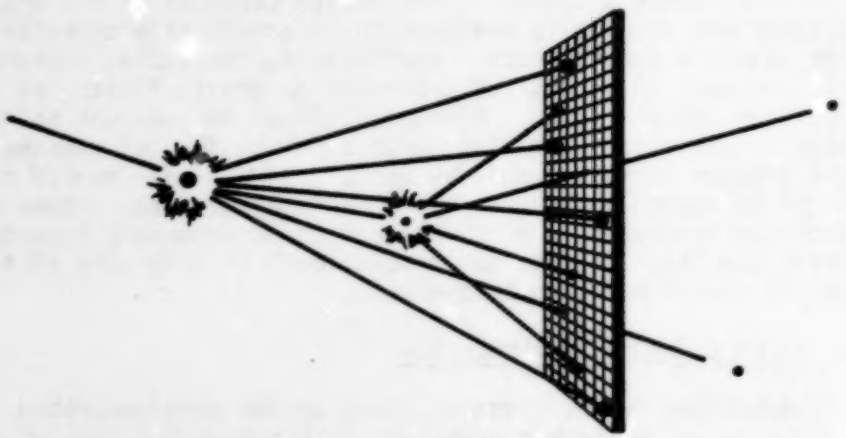
EPA considered a change in the design capacity of the project. The project was originally designed for a growth rate considerably greater than the present rate. Furthermore, the sizing appears to be out of line with DRCOG desirable population growth limits for the metropolitan Denver region. However, EPA has decided not to require a change in the system capacity at this point, for two reasons: (1) the greater capacity would be useful for a longer period of time and might be needed if longer drying and storage times became necessary for pathogen reduction, and (2) the effect on secondary impacts (air pollution and land use from new populations) is only very distantly related to sludge handling subsystems.

Lowry Disposal System Modification

Alternatives to the present Lowry system were described in the EIS. Metro's new anaerobic digesters will change the type of sludge

being applied to the Bombing Range. Some form of composting/drying and storage could be instituted at Lowry to allow eventual reuse of some or all of the sludge. It is possible that more land could be acquired at the Bombing Range to improve the soils and vegetation without accumulating excess metals in the soils or nitrates in the groundwater reservoir. These systems have not proven to be practical as long-range solutions to Metro's sludge management problem.

POTENTIAL IMPACTS, MITIGATING MEASURES, UNAVOIDABLE EFFECTS AND LONG-TERM IMPLICATIONS



The evaluation of environmental impacts was carried out in this EIS in the following way. A description of potential positive and negative impacts from the proposed Metro system was provided. Wherever possible, impacts were quantified with reasonable basic assumptions regarding the system and prevailing conditions. Where quantification is difficult due to lack of basic data or an imprecise state of knowledge, ranges of possible impacts or qualitative statements of impacts were made. In all cases, thresholds of significance for impacts were determined from the experience of the professionals on the environmental team and from knowledge of local conditions.

Potential mitigative measures were developed for reducing the severity of potential impacts. Section VII is devoted to a listing of negative or adverse effects that cannot be avoided and of the long-term implications of the proposal. From these measures, certain ones were chosen as

grant requirements for the project.

The EIS looked at three basic areas in analyzing the environmental impacts: Metro's proposed system, including digesters, pipeline, site and drying/processing/storage facilities; off-site areas where the sludge is likely to be applied; and the part of the Lowry Bombing Range containing the existing Metro sludge processing system. Schematic representations of impacts in these three basic areas of concern were presented in Figures 16, 17 and 18 in Volume I.

Table B provides a rough summary of the major impacts expected from the proposed Metro system and the existing Lowry operation, divided into the same three basic areas. This table also summarizes possible mitigating measures and those adverse effects that cannot be lessened, and those actually selected for the project.

Sludge Drying and Distribution Site

The most serious negative environmental impacts at the sludge drying and distribution center are on soil productivity, groundwater quality and the public health through nitrate pollution of groundwater and pathogen problems. Other minor impacts will occur to downstream water users because of increased consumption of water; some impact will also be felt from occasional odors. Very little mitigation of the soil destruction is possible; groundwater effects and exposure of the public to pathogens will be controlled with proper measures as shown in Table B.

Land Application Areas

Land application areas hold both the greatest promise for benefits as well as potential detrimental impact from sludge application. On the positive side, the Metro proposal would lessen overall energy use--in comparison with commercial fertilizers, which require energy for their production--by taking advantage of solar heat in the drying process. A beneficial effect is expected on the soil structure and moisture-holding capacity of the soil as a result of sludge application. Properly applied, the nutrients in sludge can replace some commercial fertilizers. Sludge nitrogen is also of the slow-release form that would be available to plants over a number of years, somewhat in harmony with plant needs.

The principal negative features of the application of sludge on farms and gardens are keyed to the specific kind of land use involved. Dryland farms have different (lower) requirements for amounts of nutrients and sludge from those of irrigated areas. Exposure to pathogens will differ greatly, depending on whether sludge is applied to farmland or to city parks and home gardens.

Table B. SUMMARY OF MAJOR POTENTIAL IMPACTS, MITIGATION MEASURES AND UNAVOIDABLE EFFECTS
(Underlined mitigation measures indicate those chosen for this project)

Environmental Parameter	Impact	Importance	Severity of Impact	Mitigation[a] Feasibility	Mitigation[a] Methods	Unavoidable Effects[a]
			Sludge Drying, Storage and Distribution Site			
Soil/Land	Destruction of Profile Loss of 200 acres of productivity (~ $100,000/yr)	moderate	Confined to site, severe	-	NA	Elimination of Agriculture in the site; destruction of wildlife habitat
Groundwater	Nitrate and salt	high	Potentially severe	+	(1) Line basins; (2) Remove decant; (3) Collect drainage; (4) Promote anaerobic conditions	Mitigation will increase project cost
Water Quantities	Removal from South Platte	minor	moderate	P	(1) Avoid irrigation; (2) Return water	
Air Quality	Odor generation, particulates	negligible	Negligible except with digester upset; particulates in severe wind	P	(1) Bury sour digester contents elsewhere; (2) Keep stockpiles moist	Minor odors on calm days, some particulate dispersal in severe winds
Public Health	Pathogen survival and vector proliferation; airborne particles	high	Low, except with loss of control	+	(1) Medical attention; (2) Insect control (3) Berms & wetting sludge	None
Energy Use	beneficial	moderate		NA	NA	NA
Nutrient Resources	beneficial	high		NA	NA	NA
			Sludge Application Areas			
Food Chain	Magnification of heavy metals, especially Cadmium	high	Low under strict controls	+	(1) Limit sites, crops[(b)] users, rates; (2) Control heavy metals at source	Heavy metals contamination in soils; exposure of burrowing animals to toxic elements
Water Quality	Nitrate and salt concentration	high	Minor on drylands, severe on others	-	NA	Long-term cumulative effect in entire region

Soil Productivity	beneficial	high		NA	NA	NA
Soil Salinity	adverse	moderate	High on dryland farms only	-	NA	Long-term cumulative effect in dry farms
Plant Nutrition	beneficial	moderate		NA	NA	NA
Energy Use	Fuel requirement for trucking	moderate	Lower than present operations	+	Develop markets in vicinity of site	Moderate fuel consumption
			Lowry Bombing Range Existing Operations			
Food Chain	Domestic animals grazing on sludge-amended fields	high	Potentially severe	+	(1) Restrict grazing; (2) Control heavy metals at source	Heavy metals accumulation in soils
Public Health	Exposure of people in parks and home gardens to pathogens	very high	Potentially severe	+	(1) Longer drying time; (2) Medical attention	
Soil Productivity	beneficial	low		NA	NA	NA
Soil Salinity	Salt buildup in root zone	moderate	moderate	P	(1) Remove decant; (2) Spread over larger areas and lower the loading rates	Gradual salt buildup in the region
Groundwater Quality	Nitrate pollution, salt increase	high	Low to potentially severe	-	NA	Groundwater pollution in irrigated farms
Air Quality	Odors	low	Low except with digester upsets	+	(1) Source control of toxic materials; (2) Optimal operation of digester; (3) Burial of sour digester sludge	Complaints from neighboring areas
Energy	Use of large amounts of fuel for transport	moderate	high	+	(1) Use of anaerobic sludge reduces total load, produces gas	Loss of energy; resources wasted
Chemicals Resources	Use of conditioning chemicals (ferric chloride and lime)	moderate	high	+	Use of anaerobic digesters	

[a]The symbol + indicates totally feasible; - indicates infeasible; P indicates feasible in part; NA indicates not applicable.

[b]State Regulations.

The principal areas of concern in applying sludge to lands on which various kinds of crops for human use are grown would be: nutrient loadings, toxic or plant-inhibiting effects of heavy metals, salt accumulation in the soil profile and food-chain effects (the gradual buildup of trace elements in plants and animals or in humans consuming the plants and specific organs of the animals). Other concerns involve effects on groundwater and runoff effects on water quality. The latter are not considered very significant overall because of the projected recommended loading rates considered for this semi-arid area.

Each of the above problem areas will be mitigated to a large extent, either by controlling how much sludge is applied and where it is applied or by source control of heavy metals and greater treatment at the Metro facility. Such measures will require greater managerial control by the Metro District as to the final disposition of sludge. Legislation was passed in the State of Colorado to remove sewage sludge from the category of solid waste and set up a new statute to recognize the agricultural benefits of sludge in closer harmony with existing public health laws. In turn, the State Health Department is establishing regulations defining where and how sludge could be applied to the land.

In the present EIS, EPA has provided recommended measures for minimizing the environmental impacts of the use of sludge on land areas. The most important condition will be that Metro will not be allowed to distribute sludge until State regulations are finalized.

Disposal Operations at Lowry Bombing Range

The impacts associated with the continued use of the existing system, including final disposal of sludge at the Lowry Bombing Range, were considered generally negative at this point. The existing system uses considerably more energy and chemicals than would be required with the Metro proposal. Little agricultural productivity, even grazing forage, is now derived from Lowry rangelands. At the present rates of application, there could be discernible effects on groundwater quality around the landspreading area in the future, and heavy metals will accumulate in the soils. Since cattle grazing is the chief use of Lowry lands, possible toxic chemical buildup in cattle tissues will have to be monitored. A study is underway at present, funded by the U.S. Food and Drug Administration, to determine what heavy metals buildups are taking place in cattle now grazing on the sludge application areas. Cattle are known to ingest a substantial amount of soil as part of their diet. The only long-term mitigation is to stop the present form of disposal at the site and allow the lands to gradually restore themselves.

Long-Term Implications

The Metro proposal offers an opportunity to increase the use of renewable resources as well as to lessen the use of non-renewable materials. The extensive use of chemicals can be eliminated. The sludge drying and distribution proposal will lessen Metro's consumption of dwindling fossil fuels; reuse of nutrients would also lessen the amount of fossil fuel needed to produce these fertilizers. Soil productivity could be improved by recycling carbonaceous material to the soil. Solar energy would replace the fossil fuel energy needed to dry the sludge. Additional gas from the anaerobic digestion process would also substitute for commercial fuels at the Metro plant.

Long-term uses of heavy metals in sludge on soils are not expected to significantly deteriorate soil quality if the conservative application rates are followed. Some metals could be beneficial as micronutrients to crops.

THE IMPORTANT ISSUES AND THEIR RESOLUTIONS

In the draft EIS, the Summary accompanying the EIS listed what EPA felt to be the most important issues surrounding the Metro offsite solids proposal. These represented our best judgment at the time. Since then, the many comment letters and discussions we had in the public hearings have raised other important issues.

The following list was developed from the above sources and indicates where EPA must make a decision about these issues or problems. They are in the form of questions, in order to better focus on the specific problem facing this project. There were other issues raised that we felt could be best answered directly to the letters. This is done in another section of Volume II. The issues here represent the ones most often raised or felt to be the most critical. The issues are separated into different categories; I, those involving the proposed changes at the central plant and pipeline; II, site-related issues; III, present operation at Metro; IV, alternatives; and V, sludge use issues. (This summary discussion of issues parallels the more detailed discussions of issues in Volume II. The same identifying numerals are used.) EPA's proposed action or reaction to the issue questions are given as answers.

I. CENTRAL PLANT AND PIPELINE ISSUES

Issue I-1. What kind of source control at the Metro plant is needed to limit concentrations of heavy metals and persistent organics such as polychlorinated biphenyls (PCB's) and pesticides for sludge application to the land?

EPA has concluded that based on the present information and criteria, none of the identified contaminants require immediate special pre-treatment. EPA will be following a national policy under the 1977 Amendments requiring additional pre-treatment for industries discharging to municipal treatment plants. Metro is still beginning its study to identify who its industrial dischargers are and what they're discharging. EPA on a national level is also working on regulations and guidelines for acceptable levels of toxic pollutants in sludge; when this information is available, it will be integrated into requirements for the Metro District. In the long run, Metro District will be required to reduce the amounts of heavy metals and toxic substances entering the sludge to create a better agricultural product.

Issue I-2. Please provide a better description of the proposed pipeline, routing, existing conditions and impacts along the pipeline right-of-way.

This has been done in Volume I of the EIS and in the Issues discussion. We concluded that the impacts are not that significant.

Issue I-3. Will the added use of water in the Metro offsite solids project over that now presently used for sludge treatment involve a water rights conflict and create a significant downstream impact?

We conclude that the amount of water involved in the offsite project compared to flows in nearby irrigation ditches is negligible. More importantly, the Denver Water Board has control over much of Metro's wastewater and has not indicated that there is any problem from their point of view. Metro thinks that it is legally correct for them to use the additional water as part of the sludge treatment process. There is still the potential for disagreement on this issue, however.

Issue I-4. Will the proposed project affect historical/archaeological resources and is a survey required?

Metro has had a surface archaeological survey done for the final three sites (including site B-2) in its selection process. No significant resources were indicated on site B-2. The State Archaeologist has reviewed the pipeline route and indicated that a preliminary survey is not necessary. EPA will require Metro (per the recommendations of

the State Archaeologist) to have an on-site archaeological monitor for the first part of the pipeline construction (from the plant to Colorado Boulevard). The remainder of the route and the site construction would be supervised by Metro personnel who have been familiarized with archaeological artifacts. A procedure for notifying the State Archaeologist in the event of a find will be followed (see Grant Conditions in Volume II, Appendix A).

Issue I-5. What is Metro's contingency plan for a pipeline break?

Metro will have redundant equipment in the form of dual pipelines and pumps to handle most emergency situations. The line will be extensively monitored electronically; there are also shutoff and blowoff valves along the line that can be triggered automatically. Metro will detail just how it will respond to a variety of different emergency situations with the pipeline in the required Operations Manual to be developed by Metro in Step II of this project. See Grant Conditions.

Issue I-6. How would Denver Northside Treatment Plant's sludge be handled in the Metro offsite solids proposal?

Until the comments on the draft EIS for this project were received, it has always been assumed that Northside sludges (which are now treated at Metro) would be part of the sludges to be sent to the offsite drying basins. The City of Denver is now interested in pursuing separate treatment for the Northside sludge. The merits of this suggestion are discussed under Issue IV-3. If Northside sludge is processed in the Metro offsite project, there are potential cost savings for Northside; there may also be benefits to Metro as well from added flexibility to stabilize the raw sludges. The Denver Parks Department would be guaranteed sludge for parkland use in the offsite system. EPA recommends that management from Northside and Metro get together to work out the optimum arrangement for both parties within the offsite solids system. See Grant Conditions.

II. SITE-RELATED ISSUES

Issue II-1. Please provide a better description of existing conditions at site B-2 and a better definition of on-site environmental impacts.

An expanded description of existing conditions and impacts at site B-2 can be found in this discussion. Information is also available in the EIS in Volume I, Section III and Appendix E.

We conclude that there will be a significant impact as a result of the loss of productivity of 2000 acres at site B-2. About 1 percent productivity from farming in Adams County will be lost, totaling about

$105,000 per year. This is mitigated by the fact that the potential value created by the Metro offsite operation could be much greater (see Issue II-8). Some of the land on the site could continue in agricultural production.

Issue II-2. Will groundwater deterioration occur, particularly in the Lost Creek aquifer, and what mitigating measures such as lining are necessary?

This is perhaps the potentially most severe impact expected from the project. EPA will require that certain performance standards be met in the construction of the basins to insure minimizing leaching to the groundwater. Metro will be required to demonstrate by whatever means it chooses to see that an impervious layer equivalent to a compacted layer at least 12" thick with 12" of cover material meets a permeability limit of no greater than 1×10^{-7} cm/sec, wherever liquid sludge will come into contact with the ground. Further, Metro will be required to monitor the groundwater beneath the site for a variety of pollutants. If drinking water quality standards are violated, Metro will also have to pump the contaminated groundwater to the surface for treatment. See Grant Conditions.

There will still be some residual water quality effects from site leaching even with these mitigating measures. At present, EPA believes they are minimal and not a cause for concern.

Issue II-3. Will odors create a problem in the vicinity of the site either from normal operations or with digester upsets?

EPA does think there will be some occasional odors, even under normal operations, that would principally affect the two residences closest to the site. Metro will be required to submit a contingency plan in the Operations Manual to make sure that emergency burial measures of sour digester contents do not create an odor problem.

It is still somewhat uncertain as to how often and how bad a problem odors from normal operations would be for the closest residents. Metro must be prepared to compensate these residents if the odors create a nuisance.

Issue II-4. Will land values in the area decrease as a result of the Metro project and should Metro purchase a buffer zone to compensate owners?

Predicting what the economic effect on nearby lands will be from this project is very complex. The area is far enough away from the metropolitan area now to probably be out of the range of urban development speculation; as the city grows, this situation will undoubtedly

change. The project should have no effect on agricultural land values. We do not think any compensating measures are required.

Issue II-5. Will wind transport of stockpiled sludge create hazards offsite?

The fierce, high winds we occasionally experience in Colorado could move some of the dried sludge product offsite. We do not believe it to be a potential public health problem, but it could be a nuisance. Metro intends to wet down the sludge during these conditions. Hydrants will be placed in the stockpile area. EPA will further recommend that Metro construct berms to protect the sludge against wind movement. See Grant Conditions.

Issue II-6. Is the design of the runoff retention system sufficient, especially during extreme rainfall events?

EPA's consultant has evaluated the design of the runoff retention system. The design appears satisfactory for most runoff situations. The Metro District will have to apply for an NPDES Permit to discharge to surface streams.

Issue II-7. Should final EIS completion await the site designation process of Adams County?

The County feels that Metro should go through the site designation process required for a solid waste disposal site (this project site operation falls under this category), before EPA completes the EIS process. EPA has decided to finish the EIS process first in the interests of time, and also to provide technical information to County decision makers.

EPA will require that the site designation process be finished before Metro can receive design and construction funds for this project. If a site change is necessary, EPA will write a supplement to the EIS.

Issue II-8. How does the loss of farmland productivity from site B-2 compare with the agronomic value in the sludge?

EPA thinks that the offsite solids project could potentially create more value than would be lost through eliminating farming on site B-2. The estimated value of the sludge as a salable item ranges from $288,000 to perhaps over a million dollars per year. This compares with a farm productivity loss of some $105,000 per year. The higher values for the sludge would occur if the sludge product were upgraded (bagged products, sold in retail stores, or mixed with chemical fertilizer components). In the balance, the net economic effect would be positive.

Issue II-9. Are land uses in the vicinity of site B-2 compatible with the proposed Metro operation?

EPA thinks they are at present. The project is an agriculturally related one, and would sit in an area of dryland farming. Future activities such as a regional airport for Adams County and urban development would probably be less compatible. We think the likelihood for development is still many years away. The airport and sludge site could be compatible. The airport could use the sludge site as a flyway area that would stay as open space.

Issue II-10. Will insects and birds be attracted to the B-2 site and create a future hazard for airport traffic?

EPA does not think that this is an imminent hazard. We have not been formally told that the airport will even be located close to the site. Adams County did inform us that they were strongly considering a site for the airport about two miles to the west of site B-2.

Insects will be controlled by Metro in the basins. They are working with a State entomologist to develop a vector control program. This will keep to a minimum food that birds could use. There does remain the possibility of having birds hit by airplanes. We have looked at a few other similar situations and decided that there is only a very small chance that birds would be attracted to the site and cause a problem for aircraft. EPA will require that Metro minimize weeds and aquatic growth in the site reservoir. See Grant Conditions.

Issue II-11. Is this project of such an untested nature as to require further research before the project is built?

We do not think so; drying and selling sludge for agricultural use is being practiced around the country. We have provided a list of these communities. There are some genuine research issues (especially ones dealing with Western semi-arid conditions) that need studying. Metro's proposed research and demonstration areas could provide some of these answers. There are also some long-range research issues that are being studied nationwide. EPA thinks that enough information is available to go ahead with this project.

Issue II-12. Is the drying basin capacity sufficiently designed?

Yes, there is sufficient design at present and for the projected design year tonnage.

Issue II-13. How soon will additional capacity be required at the sludge basins, and will more land be required?

The project was designed to treat a certain capacity by 1985. Metro based their calculations on a faster growth rate than now exists. EPA thinks they could well have enough capacity to last to the year 2000. Additional basin capacity could also be added onsite. We don't think more land will be needed.

Issue II-14. Is site B-2 at such a distance from potential markets as to affect sludge marketability, and is there a better site elsewhere?

EPA thinks that while there might be a slightly better site closer to the metropolitan area, it would conflict sooner with urban growth. Metro has a large number of options as to where they could market their sludge product. These markets are quite dispersed and no one site is ideally suited for all of these markets.

Issue II-15. What are Metro's plans for emergency disposal of sludge if the markets do not develop as expected?

If a market for the sludge does not develop as expected, Metro plans to temporarily store it onsite and, if necessary, dispose of excess dried sludge by landfilling at the Lowry site.

III. PRESENT OPERATIONS

Issue III-1. Could the sludge disposal operation now used by Metro at Lowry be continued or modified, instead of the offsite solids project?

Metro has told us that they could continue to use the Lowry site indefinitely for sludge disposal. It would be very expensive, and would waste valuable materials in sludge. The draft EIS discussed the possibility of using the Lowry site as a storage area for sludge dried at the plant and shipped there by truck. This would allow the sludge to be recycled, but it would still be expensive. Also the kind of sludge that has to be treated at Metro does not dewater well and might make this alternative unworkable. EPA thinks that this operation is not a good long-run solution.

IV. ALTERNATIVES

Issue IV-1. Should another site for the offsite solids project, particularly the Lowry Bombing Range and the Rocky Mountain Arsenal, have preferentially been chosen?

There is merit to using public instead of productive private lands for this project. Metro did try to obtain lands for this project from the General Services Administration, the Rocky Mountain Arsenal, and the Lowry Bombing Range without much success. EPA thinks that Metro did a satisfactory job in looking at alternative sites for this project. We did look at Lowry (where Metro is now landspreading sludge) more closely as a site for the recycling project. We concluded that it is probably an acceptable site, although not an ideal one. We think B-2 is a better site. Acquiring the land at Lowry is probably the biggest problem. EPA does recommend that Metro try to obtain a Lowry site if B-2 is not chosen.

Issue IV-2. Why couldn't alternative technologies like incineration, thermophilic digestion, "the Swedish method", or pyrolysis be used instead of the Metro offsite solids proposal?

The EIS does look at a wide variety of alternative technologies that could have been used for this project including the ones ventured here. EPA still thinks Metro made the best overall choice. The above technologies were suggested by commenters on the draft EIS. Except for incineration, these technologies are still experimental. They also have considerable problems of their own. Metro has stated that if the offsite project were not built, incineration would be their next choice.

Issue IV-3. Should EPA participate in separate planning and funding for Denver Northside Treatment Plant sludge disposal as suggested by Denver?

EPA analysed the rough cost figures given by Denver for their alternative plan for separate Northside sludge treatment. We concluded that it would cost Denver a lot more money in the long run to go separate. Based on EPA cost-effective criteria, EPA will not participate in funding for a separate Denver system.

Issue IV-4. What alternatives are available to control groundwater quality at site B-2?

Discussion of alternative systems is provided in Volume II. Lining was chosen as the most cost-effective solution.

V. SLUDGE USE ISSUES

Issue V-1. Will EPA place constraints on sludge use because of public health problems from pathogens, salt accumulations or effects of toxic substances (especially heavy metals and organics)?

The three areas--pathogens, salts, and toxic materials--were identified as the principal constituents of most concern in sludge. EPA considered placing constraints if necessary on certain uses because of these problems. We now feel that there is not enough evidence to suggest that any particular facet of Metro sludge or the design of this project would require special constraints on sludge use. Pathogens will be effectively killed for most uses with the combination of anaerobic digestion and drying/storage. Salts (upon receipt of better information) do not appear to be as great a problem as was earlier estimated. Heavy metals and organics appear to be within tolerable limits as defined by Federal and State guidance.

EPA still recommends that a cautionary approach be used where human food chains are involved. The next issue describes where such cautionary approaches are needed. EPA will periodically be providing new guidance on acceptable limits for these various substances. In new regulations required under the 1977 Amendments, EPA will recommend a constraint on Cadmium. See Grant Conditions.

Issue V-2. Should constraints to Metro sludge use be set depending upon the kinds of use contemplated?

The following areas of caution should be observed for the various uses contemplated: city parks - avoid contact with human activity; home gardens - avoid use on leafy vegetables and crops that uptake heavy metals, and crops that can be eaten raw; irrigated farms - avoid situations similar to home gardens; and dry land farms - avoid wide-scale use until better studied on small operations, avoid over-fertilizing. These recommendations will be proposed to Metro District as guidelines for its users. See Grant Conditions.

Issue V-3. Are Metro's plans for use reasonable and compatible with market trends?

EPA thinks that although a market survey might be helpful now, this marketing work will have to be done eventually by Metro to make the project successful. There does appear to be enough different markets to use the final product.

Issue V-4. How will controls over sludge use and management be implemented by Metro, the County, the State or others?

The primary guiding force for management and control of sludge will be through State control. The State is now developing guidelines for application of sludge to land. EPA will require Metro to store the dried sludge on-site until such time as the State guidelines are passed (with the exception of municipal parkland users). See proposed State Guidelines in Appendix B, Volume II.

Issue V-5. What are the long term implications for sludge recycling to the land?

EPA concludes that the prospects are generally favorable--added soil tilth and moisture holding capacity, the recycling of nutrients, etc. The cautionary problems - heavy metals accumulations, salts, and pathogens--are not believed to be serious enough to work against the overall benefits of sludge recycling. Work in the future to reduce present sludge contaminants should make municipal sludge a better material to recycle to the land.

Readers of this document and of the EIS it summarizes are requested to comment with respect to contents, conclusions and the project evaluated. All comments may be addressed to:

Regional Administrator
U.S. Environmental Protection Agency
Rocky Mountain-Prairie Region VIII
Suite 900
1860 Lincoln Street
Denver, Colorado 80203

Copies of the full EIS may be reviewed at Public libraries and the libraries of Colorado State University and the University of Colorado as well as at the address shown above. EPA will not make a final decision on this EIS until